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Solid Earth Discussions

Interactive comment on "Up the down escalator: the exhumation of (ultra)-high pressure terranes during on-going subduction" *by* C. J. Warren

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Many thanks to Prof Gerya for providing this comprehensive and invigoratingly critical review. I have tried to separate out the pertinent comments and respond to them below:

Title and concept:

I agree that the title didn't fit the contents. My original aim was to write a review of continental UHP terrane formation and exhumation but the manuscript strayed a bit from the original aim and thus got a bit fluffy. I will re-work both the manuscript and the title. However I do not agree with the reviewer that either the title or the "up the down escalator" concept is "wrong". I agree that it is limiting in that it only looks at exhumation in a subduction channel but that does not make it "wrong". I will re-work

the text to expand and clarify so as to not mislead the reader.

Misleading statements in abstract: buoyancy, detachment:

I will re-work this to make sure that the statements are neither misleading nor false. I still consider buoyancy to be a major driving force in the exhumation of continental crust, as the vast majority, if not all, exhumed continental UHP tracts may be shown to be less dense than the mantle at their peak PT conditions (see e.g. Walsh et al., 2004). The relative balance between buoyancy and tectonic forces is, in my opinion, the interesting question, as is whether this is determinable from the geological record. Numerical models are at their most interesting and useful when their predictions are comparable and testable against the geological record.

Short, fragmentary introduction:

I agree that the introduction as it stands does not introduce a "take home message" – also highlighted by Reviewer 2. This will be thoroughly revisited in the revised version.

Literature not comprehensive nor up-to-date:

I agree that a few key papers were missing and thank the reviewer for pointing some out. However I do not agree that all the suggested modelling papers are relevant for a review on a discussion of continental crust exhumation.

Prescribed velocity models, isoviscous channel flow, overstatement of significance of channel flow:

I agree that my experience with modelling this problem is through prescribed velocity models. I will make sure that any mis-leading statements are corrected, and that the discussion is not purely based on channel flow.

Mention of more recent strain and melt-weakening papers:

Thanks for highlighting some relevant papers here – I will incorporate them into the discussion where relevant.

Driven cavity flow:

Thanks for pointing out that driven cavity flow can exhume material at rapid rates in theory. I will correct the text.

Omission of “important” topics such as tectonic overpressure and temperature discrepancies:

This paper aimed to focus on exhumation mechanisms and driving forces, and as such I do not personally think that the “issue” of tectonic overpressure is all that important. As far as I understand it, there is uncertainty in the barometric estimations from natural samples of $\pm$ 0.2 GPa, which is within the uncertainty of the overpressure estimates from the model results. This results in an uncertainty in the order of 5-10 km on the depth to which these rocks are subducted. I don’t think we can tell from the rocks themselves whether the pressure they have experienced is lithostatic or not... so is this really a major issue? Equally, the issue of temperature differences between models and nature is an interesting sideline but in my opinion not so relevant for a discussion on exhumation mechanisms.

Important exhumation concepts not addressed: eduction, slab break-off, crustal-scale stacking:

Thankyou for highlighting the eduction papers of Duretz et al – I did not know that these papers were yet out. The term “eduction” however is not yet all that common in the UHP community, but I agree the models seem to help describe the data from Norway. I will include a section on this mechanism in the revision. Equally, I agree that mention of slab break-off and crustal scale stacking is important, however I disagree that either of these is an exhumation mechanism as such, more a process which may or may not be happening contemporaneously as exhumation. It has been show in many cases (natural and modelling) that slab break-off is not necessarily required for exhumation.

CJW 17th September 2012

Interactive comment on Solid Earth Discuss., 4, 745, 2012.